

VERIFICATION OF THE SURFACE ENERGY BALANCE IN MESOSCALE NUMERICAL WEATHER PREDICTION MODELS.

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Scientific Research Theme(s): Surface Radiation, Soil Moisture, Surface Fluxes, Air Quality

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Scientific Impact: Improving the surface energy balance in mesoscale meteorological models used to forecast atmospheric chemistry.

Reference: Zamora, R. J., S. Solomon, E. G. Dutton, J. W. Bao, M. Trainer R. W. Portmann, A. B. White, D. W. Nelson, and R. T. McNider, (2003): Comparing MM5 Radiative Fluxes with Observations Gathered During the 1995 and 1999 Nashville Southern Oxidants Studies, *J. Geophys. Res.* (In press).

Atmospheric chemistry models usually require forecasts of boundary layer wind, temperature, mixing ratio and mixing depth from mesoscale numerical models as inputs. Uncertainty in these forecast variables can have a significant impact on the concentrations of surface ozone and other pollutants that are estimated using the air chemistry models.

One large source of error in the meteorological models can be traced to the representation of the surface energy balance. During the 1995 and 1999 Southern Oxidants Studies (SOS) the Environmental Technology Laboratory of the National Oceanographic and Atmospheric Administration (NOAA/ETL) found that mixing depths over both the rural and urban areas of central Tennessee were systematically over forecast by the Pennsylvania State University/ National Center for Atmospheric Research Mesoscale Model (PSU/NCAR MM5).

In an effort to locate the source of the errors in the forecast mixing depths ETL began deploying surface flux sites during air quality experimental campaigns. The experimental measurements include, soil moisture, soil temperature at 6.0, 8.0, 10.0, and 60 cm depth, ground heat flux at 2.0 cm depth, sensible heat flux, latent heat flux, and all four components that comprise the net surface radiation.

By comparing these observations with MM5 forecasts we determined that errors in the incoming solar and IR radiation forecast by the model were leading to the systematic increase in mixing depth. Figure 1 shows the solar radiation comparisons for the June 11-14, 1995 stagnation event. The downwelling IR comparison is shown in Figure 2.

The ETL surface energy balance observational systems have also been deployed in the Central Valley and Coastal Region of California, Houston, TX, and Durham, NH. These observations allow us to correct deficiencies in the MM5 model and enhance our understanding of how surface soil properties and radiative processes influence mixing depth forecasts.

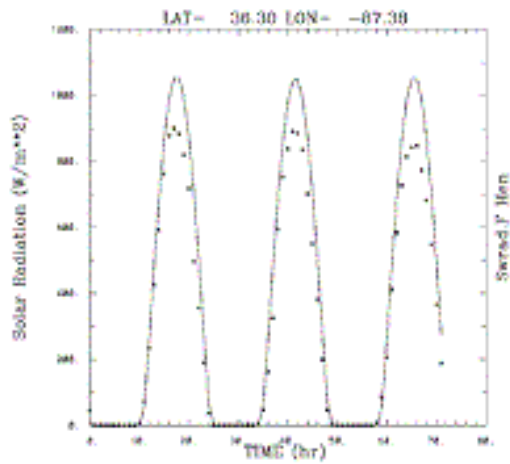


Figure 1: Solar radiative flux predicted by MM5 (solid line) and measured (asterisks) solar radiative flux at New Hendersonville, Tennessee as a function of time for 11-14 June 1995.

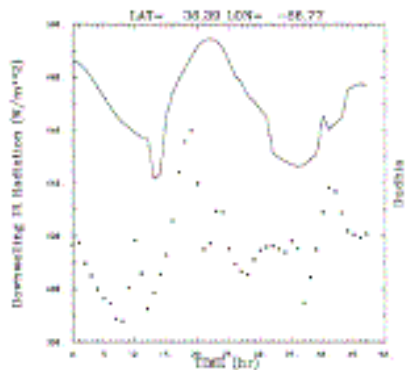


Figure 2: Downwelling radiative flux predicted by MM5 (solid line) and measured (asterisks) downwelling radiative flux at New Hendersonville, Tennessee as a function of time for 3-4 July

1999